



WATER RESOURCES RESEARCH GRANT PROPOSAL

Title: A study of vernal pool ecosystems in southern New England

Focus categories: WL, ECL, G&G

Keywords: Vernal pools, benthos, conservation, crustaceans, ecosystems, geographic information systems, insects, invertebrates, planning, ponds, remote sensing, water chemistry, zooplankton, northeastern US

Duration: March 1, 1999 to February 29, 2000

Federal funds requested: \$10,000

Non-federal: \$ 36,477

Principal investigators: Charlotte Pyle and Eileen Jokinen, University of Connecticut

Congressional district: Second

Statement of critical regional or State water problems

Vernal pools are a type of ephemeral wetland found throughout the world. Vernal pools possess many aspects of independent ecosystems differing from surrounding terrestrial environments, permanent wetlands, or permanent ponds. The pools represent a unique system which alternates between aquatic and terrestrial within any given year (Wetzel 1983). In addition, the major carbon source for forested pools is not in-pool photosynthesis but leaf litter from the surrounding forest, thus creating a detritus based system (such as found in first and second order streams (Allan 1995)).

The primary identifying characteristic of vernal pools is that they are dry for some part of the year, usually in summer and early autumn. Therefore, they do not, in our region, harbor fish populations which, in permanent ponds, act as predators. Thus, organisms (or their larvae) which would not survive fish predation, are able to survive. In north temperate zones, vernal pools are critical to the survival of several amphibians such as spotted, marbled, and Jefferson salamanders, wood frogs, and eastern spadefoot toads (Klemens 1993). These organisms, some of which are endangered, deposit their eggs in the pools where the larvae develop, metamorphose, and leave the ponds for the surrounding woodlands. Certain invertebrates, the best known of which are fairy shrimp, survive only in vernal pools, probably because of a combination of low predation rates and eggs which require freezing and/or drying to be viable (Pennak 1989). The pools also serve as habitat for hundreds of organisms which may spend all (e.g. crustaceans, mollusks) or part of their life cycle (e.g. insects with aquatic larvae) as part of the pool ecosystem. Species may survive the drying of the pool by aestivating (Jokinen 1978), by having rapid life cycles, or by leaving the pool when mature.

Because southern New England forests are becoming fragmented by suburban and recreational development, there has been an increased interest in the preservation of vernal pools as unique wetlands (Donahue 1996; Kenney 1995; Colburn 1991; Fellman 1998). Legislation defining temporary pools almost always includes the presence/absence of specific amphibians (listed above) and/or fairy shrimp because these organisms are highly visible and often fall into endangered or rare categories. Dearth of real data on the rest (95%) of the pool community, the habitat as defined by physical/chemical parameters, and the cyclical trends and patterns is forcing government groups to resort to anecdotal and oversimplified information which may result in eliminating many vernal pools from potential protection. Our observations over the past two years have noted a number of pools which do not have the "proper" amphibians, fairy shrimp, wetland vegetation, wetland soils, nor confined basins. The uniqueness of vernal pools requires comprehensive assessment at all levels: biology, chemistry, hydrology, physical characteristics (e.g. duration of drought and what controls it), and surrounding terrain.

With increased forest land development, it is important to be able to locate and protect vernal pools. However, vernal pools can require intensive field reconnaissance to locate, a time-consuming element which will discourage planners and permitting agencies from locating pools prior to development. If an easier method (model) can be developed to shorten the time required to locate pools, planners and agencies will be encouraged to direct development away from vernal pools.

Statement of results or benefits

This study aims to (1) elucidate variability of vernal pool systems, (2) determine which environmental factors are significant in structuring pool communities, and (3) provide a rationale for prioritization of general areas to be inventoried for the presence of vernal pools. We expect our results to broaden greatly the database on southern New England vernal pool ecosystems. The data will provide needed information for the protection of these small but numerous unique ephemeral habitats that add so much to the biodiversity of the landscape.

Nature, scope and objectives of the research

A. Biological/Chemical Aspects: Since February 1997, we have gathered the following field information from 26 vernal pools in southern New England (see Table 1 for list of pools): 1) Diversity data (benthos+plankton): for each sampling period and for total pond season; 2) Dominant species (or taxa) for each pond for each period and the changes in the community structure through a season (see Fig. 1 as an example); 3) Density of organisms as proportional to number of individuals caught in each pond at each sampling period (numbers of animals large enough to be caught by a fine-meshed plankton net and a dip net); 4) Length of time each pool is active (holds water) and patterns of pool filling and drying (ice and water depths) (Figs. 2 and 3); 5) Seasonal temperature changes; 6) Maximal depth and area of each pond; 7) Initial chemistry values as measured in the field (dissolved oxygen, conductivity, pH); 8) Ongoing water analyses for cations (Ca, Mg, Na, K), conductivity, total phosphorus, ammonia/nitrate, sulfur, alkalinity, dissolved

inorganic carbon, total organic matter, tannins, and lignins); 9) Whether pools are confined to basins without inlets or whether they are formed by intermittent streams; 10) Soil samples from beneath the pools with no inlets to indicate nature of subsoil and whether pool is perched on impermeable soils (clay and/or loam) or is on top of terrestrial or wetland soils; 11) Presence/absence and nature of aquatic vegetation; 12) Nature of surrounding terrestrial vegetation and resultant allochthonous leaf litter; 13) Aerial photos and GPS locations; 14) Groundwater wells in place at two locations.

The above data will be used (a) to describe in-pool community dynamics, and (b) to test whether types of taxa (copepods, cladocerans, ostracods, mollusks, etc.), total diversity (number of taxa), and community structure of the ponds are determined by a suite of physico-chemical factors.

B. GIS-based landscape profiles. The objective of this aspect of the research is to determine whether or not the general areas in which vernal pools are found are significantly different from the average conditions in the larger landscape as assessed by GIS analysis.